Novel Semiconductor-Based Epitaxial Magnetic Heterostructures

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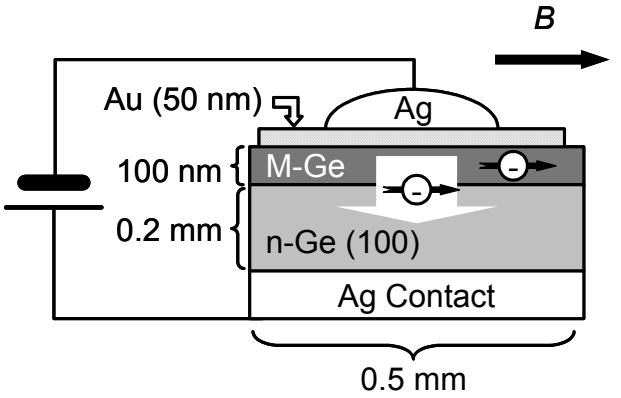
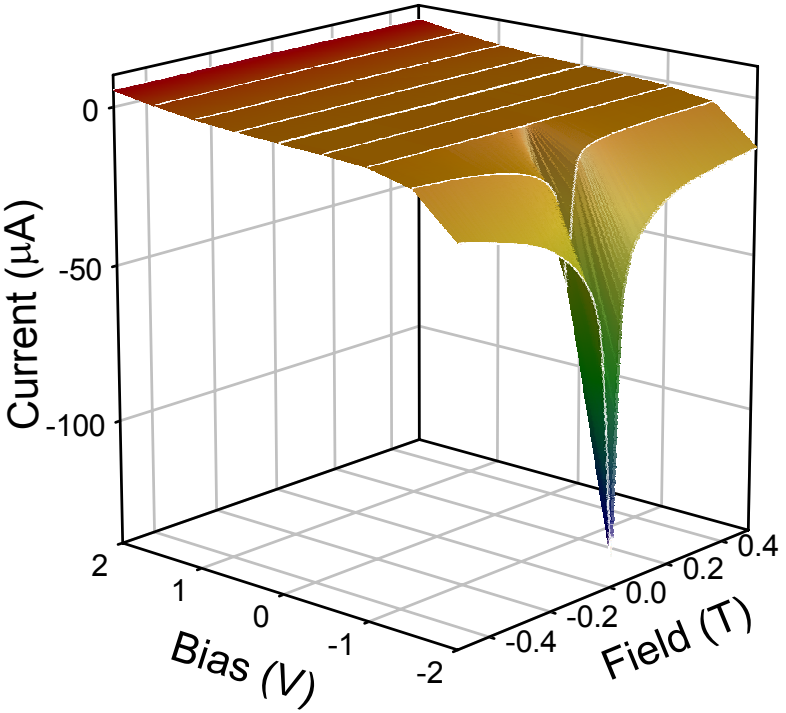
Ge-Based Magnetization-Dependent Rectifier*

- First magnetic heterojunction diode (top right) has been made using *p*-type MnCo doped Ge magnetic semiconductor (M-Ge) grown epitaxially on *n*-type Ge (n-Ge), demonstrating the viability of multifunctional spin-devices.
- The diode exhibits excellent magnetic field and electrical bias dependent rectification effect at low temperature (bottom right). Under electrical bias, the current rectification of the diode can be suppressed by applying a magnetic field.

* *Appl. Phys. Lett*. (2003); MRS news *MRS Bulletin* (2003)





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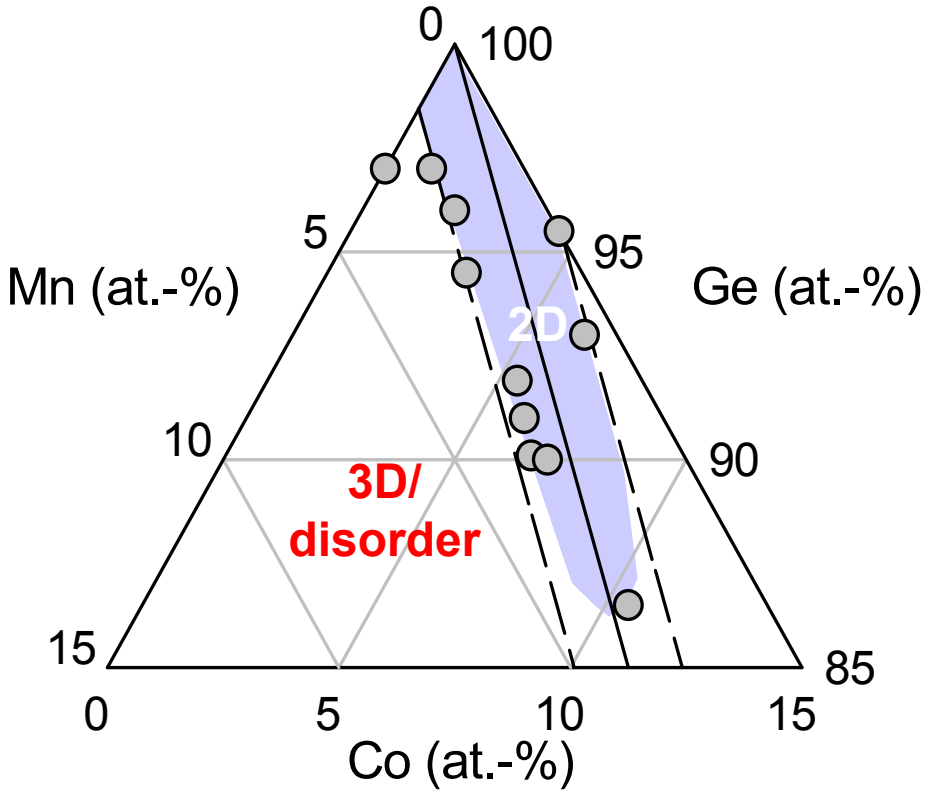
Stabilizing Epitaxial Growth at High Doping Levels through Complementary Doping*

- Epitaxial phase diagram of CoMn doped Ge (001) films (right) exhibits sharp transitions (circles) from 2D (grey area) to rough-disordered growth that depend sensitively on the relative doping concentration.
- Near the optimum complementary doping (solid line), where the internal strain in Ge due to Co and Mn doping are fully compensated, smooth 2D epitaxial growth is most stable; when the strain reaches ± 0.07 % (dashed lines), growth becomes unstable.

* *Phys. Rev*. B (2003).



Collaborations, Education and Outreach

- National Labs and small businesses
- Graduate Students (2), undergrads (4), and high school student (1)

Novel Semiconductor-Based Epitaxial Magnetic Heterostructures

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Novel Ge-Based Magnetic Semiconductors*

- Magnetism (top right) and electrical transport (bottom right) of $(Co_{0.7}Mn_{0.3})_xGe_{1-x}$ epitaxial films as a function of doping concentration.
- Complementary doping stabilizes epitaxial growth at high doping levels producing high-temperature ferromagnetic semiconductors in a group IV element.
- Novel metal-semiconductor transition (blue arrow) that coincides the structural order-disorder transition.

* *Phys. Rev. Lett*. (2003).